Solar PV design considerations – ROOF AREA

How much roof area do I need for PV panels?

Rule of Thumb
1kW = approx. 100 sf

Photo credit: CSE
Solar PV design considerations – SYSTEM SIZE

How can I approximate the system size?

Use calculator
• PV Watts
• System Advisor Model (SAM)

You can use the known variables provided by the module manufacturer to determine the approximate size of the photovoltaic array, by knowing the dimensions of the proposed modules and the voltage of the module, simple math will give you the approximate voltage per square foot of roof area which the array will occupy.

Or... for system sizing use the free tools available from NREL and others, like PV watts and The System Advisor Model (SAM)

Average PV system size
Residential - 5 kW
Small Commercial - 10-20 kW
Medium Commercial - 30-50 kW
Large Commercial - 50 kW +
When designing the roof, the PV panels and racking along will add 2-4 lbs/sqft dead load, while ballasted systems will add 4-6 lb/sqft dead load. Note, in locations with high winds, ballasted systems will need to have more weight added.

Is this dead load or live load?
Lousy Design Decisions
Now let’s talk about a few solar installation failures.

A common mistake is designing the system where a portion of the panels are shaded. This can be from the surrounding landscape or buildings, equipment on the rooftop where the system is installed, or other panels in the system. Keep in mind landscape will grow and if the property owner has permission, trees may need to be trimmed every few years. Also, neighboring new construction should be considered as well.

“After a solar system is installed it is important to properly commission the solar system. This means taking a volt meter through the system to verify you have the correct voltage inputs to the equipment being used.” http://pveducation.com/solar-installation-failures/inverter-commissioning/

For more examples of ‘what not to do’: http://pveducation.com/solar-installation-failures/

OR Aurora Solar: http://blog.aurorasolar.com/shading-losses-for-pv-systems-and-techniques-to-mitigate-them/
Lousy design decisions

Damaged roofing

Potential snow dam

Poor design/installation
Lousy design decisions

Orientation

North facing system
Lousy design decisions

String inverters

Different azimuths or inclinations in the same string

Modules of different power ratings in the same string
Lousy design decisions

Cables

No bending support

Too loose

Source: First Green

More information on planning cable layouts: http://www.firstgreen.co/2013/05/dc-cable-layout-planning-in-solar-power-projects/
Solar PV and Architectural Integration
There are many ways you can incorporate solar PV into buildings. There are conventional applications like rooftop and carports, but also many ways the solar can be integrated into the building structure with awnings, shade structures, roofs, window glazing and other architectural features.

We will now go through examples of each of these applications.
Here is an example of rooftop solar on a small business. The system is tilted rack mounted.
Here are two examples of flush mounted rooftop solar installations.
Example of a peel-and-stick roof panel system
Solar panels can also be mounted as shade structures where the solar panels can provide shade instead of standard carports or patio covers.
The support structure for the shading systems can be normal systems as the weight of a standard PV array is between 3 and 5 pounds/ft².
Snow falling into lanes of travel should also be considered where snow loads are expected.
Many Carport PV structures utilize the PV power to facilitate electric vehicle charging stations located beneath the carport array.
In addition to carports, PV can be installed on other shade structures. Here the PV provides shade for outdoor picnic areas.
Just like any other PV system, it is best to orient the panels south and avoid shading when possible, but because windows are typically vertical they will likely not have the optimal tilt. This will affect the generation output.
Creative use of standard panels

Photo credit: Eileen Blass, USA TODAY
Creative use of standard panels
Because they face south it is nice when they provide architectural shade features as well as PV power.
Standard modules can also be used to create sunshades to improve the comfort of the building occupants.